ePC-Duo

Windows/Linux Embedded Computer with dual XMC I/O, dual 10 GbE, Integrated timing support   V1.7

FEATURES

- Combines an industry-standard COM Express CPU module with dual XMC I/O modules in a compact, standalone design
- Small form factor: 3.3" H x 7.7" W x 9.8" D
- Stand-alone operation: able to operate headless
- Windows, Linux and RTOS support
- Dual PCI Express XMC IO module sites. Add anything from RF receivers to industrial control modules.
- PCI Express IO sites (VITA 42.3) deliver up to 3400MB/s to CPU memory**
- Integrated timing and triggering support for IO includes optional GPS or IEEE-1588 disciplined clock
- Supports Innovative's full line of XMC I/O module features for private data channels, triggering and timing features
- USB 3.0, Dual 10 Gb Ethernet, SATA3 x4, DisplayPort
- Wide area operation supported with dual 10 GbE ethernet links
- Up to 4 mSATA SSDs
- Mezzanine for custom I/O and interfaces
- AC (using "wall wart") or DC operation

APPLICATIONS

- Embedded instrumentation
- Remote, autonomous IO
- Mobile instrumentation
- Distributed data acquisition

SOFTWARE

- Windows, Linux and RTOS compatible
- Runs standard desktop applications
- C++ Developers Kit supporting IO integration and customization
- Device drivers, example software and support applets supplied for all peripherals

** Data rate dependent on the COM Express module capabilities

Front View

Rear View

The ePC-Duo is a user-customizable, turnkey embedded instrument that includes a full Windows/Linux PC and supports a wide assortment of ultimate-performance XMC modules. With its modular IO, scalable performance, and easy to use PC architecture, the ePC-Duo reduces time-to-market while providing the performance you need.

Distributed Data Acquisition – Put the ePC-Duo at the data source and reduce system errors and complexity. Optional GPS-synchronized timing, triggering and sample control is available for remote IO. Limitless expansion via multiple nodes. Up to 4 SSD for data logging.

Uniquely customizable - Dual XMC sites for I/O, user-controlled IO Mezzanine interfaces, triggering and timing control, USB 3.0 ports.

Remote or Local Operation - Continuous data streaming to SSD or dual 10 GbE LAN. Optional, stand-alone, autonomous operation with GPS or network synchronized sampling. See Data Rates tables on Page 5.

Rugged – mSATA SSD boot drive support in a compact, rugged 250x195mm footprint that is ready for embedded operation.

8-32V DC operation (use 12V "wall wart" for AC). Perfect for portable or automotive data loggers or waveform generators. See Power Requirements table on Page 6 for Power Ratings according to input voltage applied.

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This electronics assembly can be damaged by ESD. Innovative Integration recommends that all electronic assemblies and components circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

ORDERING INFORMATION

Product	Part Number	Description
ePC-Duo	90602 -<cfg> -<environ>	ePC-Duo – (i7 CPU) User-customizable, turnkey embedded instrument consisting of Sbc-Duo with 2.8 GHz i7 Quad Core CPU with active heat sink and fan, 32GB (2x16GB DDR4 SODIMMS, 1867MHz FSB). 4 SATA3 6.0Gbps, 4x USB 3.0, 125W 8-32V DC power supply. 75W w/o XMC modules. Rugged steel enclosure. AC to DC Power adapter excluded – must order separately. No boot/data drives or OS - must order separately. **See online web quote for all available options and accessories**
SATA3 Storage Single unit mSata modules (4 identical modules required for maximum x4 RAID configuration)	36050	120 GB module
	36057	500 GB module
	36058	250 GB module
	36059	1 TB module
192W AC-DC Power Adapter, 100/240V input 12V 16A output	80200-11	USA/Japan/Korea/Taiwan power cord
	80200-16	UK/Australia/India power cord
	80200-17	EU power cord
Mezzanine (for additional DIO)	80333-0	4 SSMC coax DIO signals per XMC Module with voltage translation
	80333-1	4 SSMC coax DIO signals per XMC Module passive (no voltage translation)
	80366-0	20 DIO signals per XMC Module on 40 pin Samtec connector, compatible with 80350-1 Breakout Module and cable. (Passive, no voltage translation)
Breakout Module w/Cable	80350-1	Breakout Module with Cable, compatible with 80366-0 Mezzanine.
GPS Timing Module	80331-0	Symmetricom GPS-500, LVDS outputs
	80331-1	Jackson Labs LC_XO, CMOS outputs
	80331-2	Symmetricom GPS-500, CMOS outputs
IEEE-1588 Timing Module	80330	Allows ePC-Duo unit to synchronize with other GPS or IEEE-1588 equipped units.

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BLOCK DIAGRAM

ePC-Duo Block Diagram
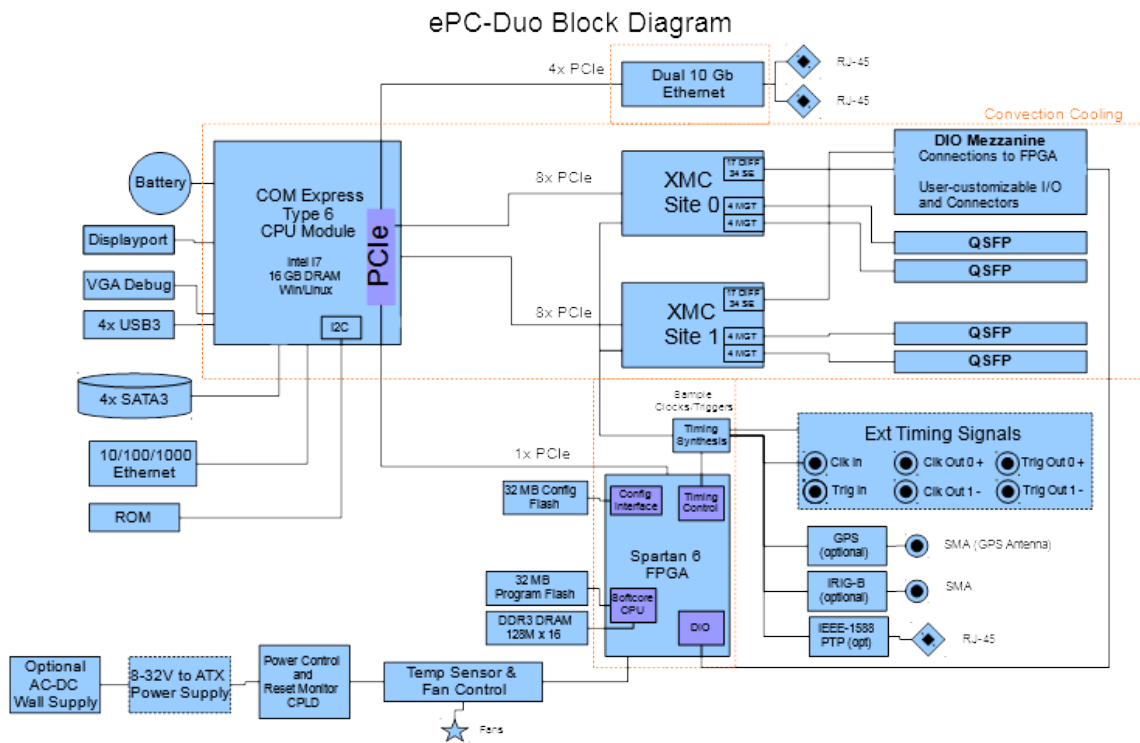
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Figure 1. SBC-Duo Motherboard
(XMC modules sold separately)

Figure 2. Rear Panel Connections
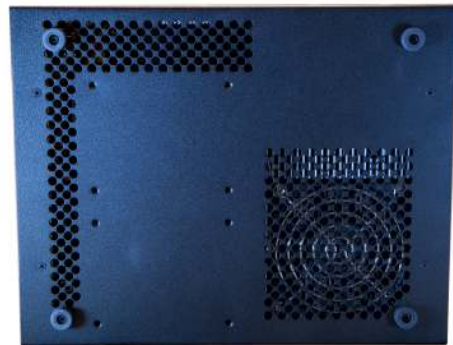

Figure 3. Front Panel Connections

Figure 4. Bottom – Convection air intakes

Figure 5. Right side – Convection air intakes

Figure 6. Left side – Convection air exhausts

ePC-Duo

Standard Features

Motherboard	
Motherboard	Sbc-Duo with ComEx Type 6 CPU

Drive Options	
Drives	Up to four SSD drives
Type	mSATA SSD drive
Interface	SATA 3 (4 x 6 Gb/s on i7 COMs)

Data Rates to SSD/RAID 0		
	Adlink i7-6820EQ	Adlink i7-4700EQ
1 SSD	450 MB/s	450 MB/s
2 SSD RAID 0	850 MB/s	850 MB/s
4 SSD RAID 0	1300 MB/s	1050 MB/s
NOTE: rates are limited by the capability of the RAID controller built in to the COM module		

Data Rates to Ethernet	
1 10Gb/s Port	750 MB/s
2 10Gb/s Ports	1500 MB/s

Data Rates to Processor Memory	
Stream to Memory	3400 MB/s
NOTE: Data rate is dependent on the COM Express module capabilities	

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Customization Features

FPGA	Xilinx Spartan 6 LX25 FPGA Controls triggering, has 34 available pin connections to the IO Mezzanine site, and has a PCIe Interface to the COM Express CPU
IO Mezzanine	80333-0: 4 SSMC coax DIO with voltage translation 80333-1: 4 SSMC coax DIO without voltage translation 80366-0: 20 DIO per XMC Module on a 40 pin Samtec connector

Power Management

Power States	Low power states supported including wake features from PCI Express and LAN
Temperature Monitors	2 total : COM Express module and ePC-Duo assembly each have a temperature sensor
Alarms	Programmable warning and failure levels
Over-temp Monitor	Disables power supplies
Cooling & Fans	Processor: heatsink assy with fan; outside air is drawn into chassis, across heatsink, then expelled from chassis. XMC sites: heatsink assy with 2 fans; chassis air is drawn across heatsink, then expelled from chassis. 10G Ethernet IC: heatsink; outside air is drawn into chassis, across heatsink, to chassis interior by chassis fan. Chassis Interior: 2 exhaust fans expel interior air from chassis. Chassis has extensive venting, allowing outside air to be drawn into the chassis.

Physicals

Dimensions (LxWxH)	9.8 x 7.7 x 4.0 in [250 x 195 x 101 mm]
Chassis material	Steel
Weight	5.9 lbs/ 2.68 kg (typical includes SSD)
Hazardous Materials	Lead-free and RoHS compliant

Power Requirements

Input	8 to 32 Vdc depending on System Power Consumption. The voltages below depict the maximum power the specified voltage can sustain. 12V = 180W, 11V = 165W, 10V = 150W 9V = 135W, 8V = 120W
Consumption ** Power is highly dependent on CPU and peripheral use. The stated power is typical use.	*Varies according to XMC and COM Express module requirements* 95W: Adlink Express-HL-i7-4700EQ COM Express Type 6, 2.1GHz processor, 6MB L3 cache, QM67 chipset, 16 GB memory
Hazardous Materials	Lead-free and RoHS compliant

Reliability

MTBF	79716 Hours*

IEEE-1588 Timing Module Option

10MHz disciplined to PTP reference

PPS timing reference input

Software stack runs on CPU

Timing resolution to <100 ns

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GPS Timing Module	80331-0, GPS-500, LVDS timing outputs 80331-2, GPS-500, CMOS timing outputs	80331-1, LC_XO, CMOS timing outputs
GPS Device	Microsemi/Symmetricom GPS-500	Jackson Labs LC_XO
Type	50 channels, parallel tracking	
Timing Outputs	10MHz, 1PPS	
Control Port	Serial Port (GPS NMEA Output). Appears as PCIe peripheral of the Comex processor.	
Time to first fix (TTFF)	Cold < 45s Warm 1s Hot Start 1s	
Stabilization Time	< 9 min to 5.0E-09 at 25C	<5 min to 1E-08 at 25C
1 PPS Accuracy	+/- 35 nsec to UTC RMS (1-sigma) GPS locked (LVDS)	+/- 50 nsec to UTC RMS (1-sigma) GPS locked

ABSOLUTE MAXIMUM RATINGS

Exposure to conditions exceeding these ratings may cause damage!

Parameter	Min	Max	Units	Conditions
Input Voltage Range	8	32	V	High and Ultra performance COM Express modules
Operating Temperature	0	50	C	Non-condensing, forced air cooling required
Storage Temperature	0	100	C	
ESD Rating	-	1k	V	Human Body Model
Vibration	-	2	g	9-200 Hz, Class 3.3 per ETSI EN 300 019-1-3 V2.1.2 (2003-04)
Shock	-	4	g peak	Class 3.3 per ETSI EN 300 019-1-3 V2.1.2 (2003-04)

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Architecture and Features

Embedded PC

The ePC-Duo architecture incorporates a Windows/Linux compatible processor – it runs the same applications as a desktop computer. The COM Express CPU module used in the design is a PC on a module and provides the computing engine, available with a range of Intel processors adhering to the Type 6 COM Express specification.

The COM Express module provides the PCI Express bus that links the XMC modules to the CPU. XMC modules install just like PCI Express add-in cards on the PC and are software compatible with PC applications. The PCI Express bus tightly couples the CPU to the XMC modules and outperforms previous generation systems by 2 to 4 times. Data transfer rate to CPU memory is 3400 MB/s for each XMC site concurrently.

The ePC-Duo provides familiar PC interfaces for expansion and connectivity: Gigabit Ethernet, USB ports, and mSATA SSD. Multiple ePC-Duo's may be interconnected into a data acquisition/computational mesh via dual, 10 Gb ethernet links for high performance I/O supporting up to ~1500 MB/s transfer rates to external devices such as other recorders or other eInstruments.

The DisplayPort monitor and USB keyboard/mouse make operation of the ePC-Duo similar to any PC. Standard PC screens supporting resolutions up to 2048x1536 are supported. "Headless" operation is also supported for truly embedded applications without keyboard/monitor/mouse attached. In the headless mode, the ePC-Duo can be remotely controlled and accessed over Ethernet or via remote protocols such as RDP or VNC, or even custom protocols including high-performance "bare-metal" UDP.

XMC IO Sites

Dual XMC IO module sites allow the ePC-Duo to be configured with a wide variety of IO modules. The XMC sites are for PCI Express mezzanine cards conforming to VITA 42.3 standard, which are 75 x 150 mm modules (IEEE 1386). The two modules are cooled by a large heatsink assembly with two fans moving air through the heatsink.

Innovative offers multiple lines of XMC IO modules: the X3, X5, X6, XA, and XU families. These module families offer a range of analog performance mated to high performance Xilinx FPGA computing cores, using Spartan 3, Virtex5, Virtex6, Artix7, and Kintex UltraScale families respectively. Innovative's Velocia architecture data packet system allows these modules to stream data continuously to system memory at rates up to 3400 MB/s – making the ePC-Duo well suited for data logging and playback functions. When configured with a four SSD RAID0 array, sustained rates to 1300 MB/s are achievable (limited by the currently-available mSata SSDs and the RAID controller in the processor module).

The ePC-Duo also supports the Atropos XMC module (made by Innovative), which provides precision sampling rate generation and triggering controls.

Special features supporting all XMC modules families are provided in the ePC-Duo for simultaneously sampling, triggering, and inter-module communications. System triggers and matched clocks are distributed using ultra-low additive jitter multiplexers to provide simultaneous sampling for the two

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modules. Modules (other than X3) can communicate over Rocket IO links exposed on QSFP connectors at up to 3.4 GB/s in each direction for real-time applications demanding low latency and deterministic performance. Each XMC module's J16 interface also routes 17 differential (34 single ended) connections to the I/O mezzanine site to support custom applications, such as generation of digital I/O synchronous with DSP processed analog I/O.

Triggering and Sample Clocks

The ePC-Duo has unique clocking and triggering features for the XMC modules. Each module receives a trigger and clock from the timing subsystem through its J16 connector. Innovative XMC modules can use these to support simultaneous sampling and unique trigger scenarios.

Sample clocks for the XMC modules can be generated using the ePC-Duo unit PLL and external clock and trigger inputs. The PLL can use either the external clock input, a GPS or IEEE1588 -disciplined clock (from an optional Timing Module), or an internal 10 MHz Oscillator as a reference; the PLL can also be bypassed, allowing the XMC modules to use the external clock and trigger directly. The disciplined clock allows multiple, remote instruments to sample simultaneously and act cooperatively. Position and time data is also available from the GPS Timing Module when installed.

IO Mezzanine Expansion

The ePC-Duo can be expanded using an I/O Mezzanine. There are three "standard" IO Mezzanines available with varying features and quantities of I/O signals; most applications can be satisfied with one of these (see the Ordering Information table). The IO Mezzanine site has 17 differential (34 single ended) connections from each XMC module FPGA plus 17 differential (34 single ended) connections from the on board Spartan6 FPGA. This allows flexibility when allocating signal connections for a custom I/O Mezzanine. Custom IO mezzanines can be designed for application-specific connectors and signal levels, generally using only a subset of the connections at the mezzanine site. The mezzanine footprint is large enough to integrate IO buffers and other logic. 3D Solidworks mechanical models and schematics for the IO Mezzanine are available for custom design support upon request.

QSFP Ports

Eight full speed (Rocket IO) SERDES lanes available from each XMC J16 connector are routed to dual QSFP connectors. Innovative XMC modules implement the Aurora protocol, supporting very low-latency inter-FPGA communications. Multiple ePC-Duos may be connected in a mesh to create complex, computational meshes to address RADAR, beam steering or other demanding applications.

ePC-Duo FPGA

The Spartan 6 FPGA provides interface logic that allows the processor to control the ePC-Duo resources by manipulating control registers in the FPGA logic. Normally the FPGA uses a standard factory supplied logic image, and it is rarely necessary to customize this logic.

The logic is loaded from an on-card ROM. This ROM is field reprogrammable, using a Xilinx USB JTAG cable and an external PC, or the internal virtual JTAG cable and the ePC-Duo's processor.

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Voltage and Current Monitoring

Voltage readings for most supply voltages (main supplies, 10G Ethernet, FPGA core, and XMCs) and XMC supply currents are available so that the health of the system can be monitored.

Remote Operation

The ePC-Duo can be operated as a remote computer or embedded instrument by using the Ethernet port. For pure embedded operation, the ePC-Duo can operate "headless" without monitor, keyboard or mouse. The system boots from an mSATA SSD.

Software Tools

Software development tools for the ePC-Duo provide comprehensive support for application development including device drivers, peripheral configuration and control, and utilities that allow developers to be productive from the start. Software classes provide C++ developers a powerful, high-level interface to the system devices that makes system integration and achieving real-time, high speed data acquisition easier.

Software for data logging and analysis are provided with every Innovative XMC module. Data can be logged to system memory at full rate or to disk drives at rates supported by the drive and controller. Triggering and sample rate controls are provided to support data acquisition applications without writing code. Innovative software applets include *Binview* which provides data viewing, analysis and import to MATLAB for large data files.

Support for MSVC, GNU and Embarcadero C++ variants is provided. Supported OSes include Windows and Linux. For more information, the software tools User Guide and on-line help may be downloaded.

Logic Tools

Though it is rare to customize the ePC-Duo FPGA logic, it can be done using standard Xilinx development tools and other development resources available from the factory. Contact the factory for details.

XMC Modules

Plug XMC modules into the ePC-Duo to build your custom, turnkey embedded instrument. Innovative Integration offers an array of ultra-performance, PCI Express XMC modules to create your solution.

Innovative XMC module families feature analog and digital IO with FPGA computing cores on high performance PCI Express modules. The FrameWork Logic development tools allow you to design in MATLAB and VHDL and rapidly implement high speed signal processing on the XMC. A list of all currently available XMC modules is available on the website here.

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